## Solar Events Student Activity Book

### I. Introduction

The sun gives us light and warmth, but it also gives us problems. The sun sends ions (charged atoms) and electrons into space at incredible speeds. When these particles interact with Earth's atmosphere, they cause several major problems ranging from power failures to zapped satellites.

Continue with this activity to see how the sun can be harmful.

### Get Info Objectives

- 1. List effects of solar events.
- 2. Describe solar effects on human activities.
- 3. Describe solar effects on electric companies.

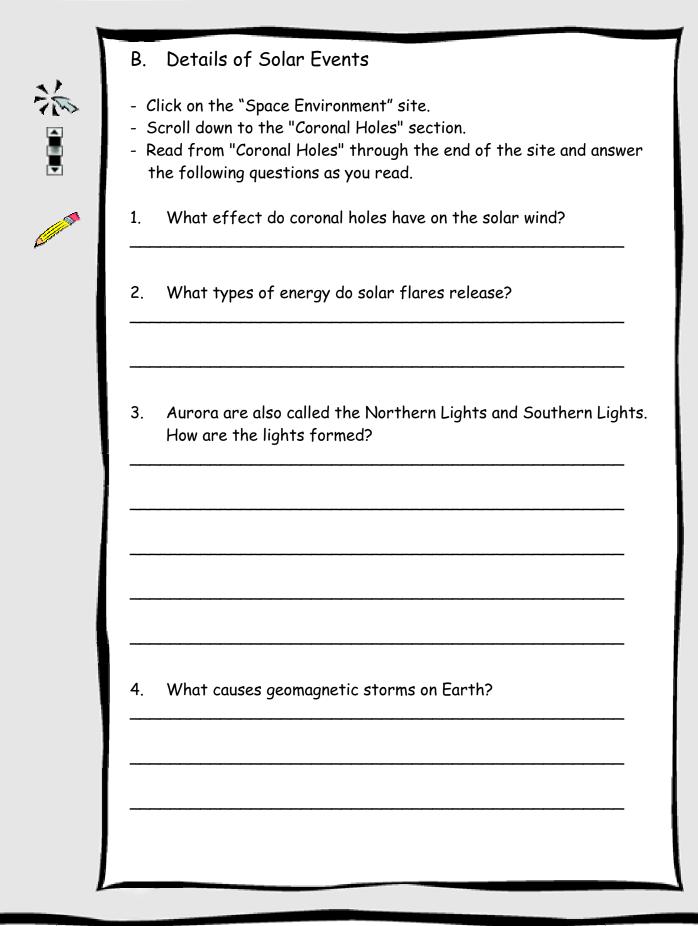
### Gather Data Objectives

- 1. Describe the relationship of geomagnetic disturbances to solar events.
- 2. Use averaged solar data to determine the best time to debug electronic equipment.
- 3. Compute the diameter, escape velocity, and surface speed of the sun.

### Application Objectives

- 1. Explain observations of the average sunspot number.
- 2. Justify the cost of an early warning system for geomagnetic storms.
- 3. Explain the international nature of solar event problems.

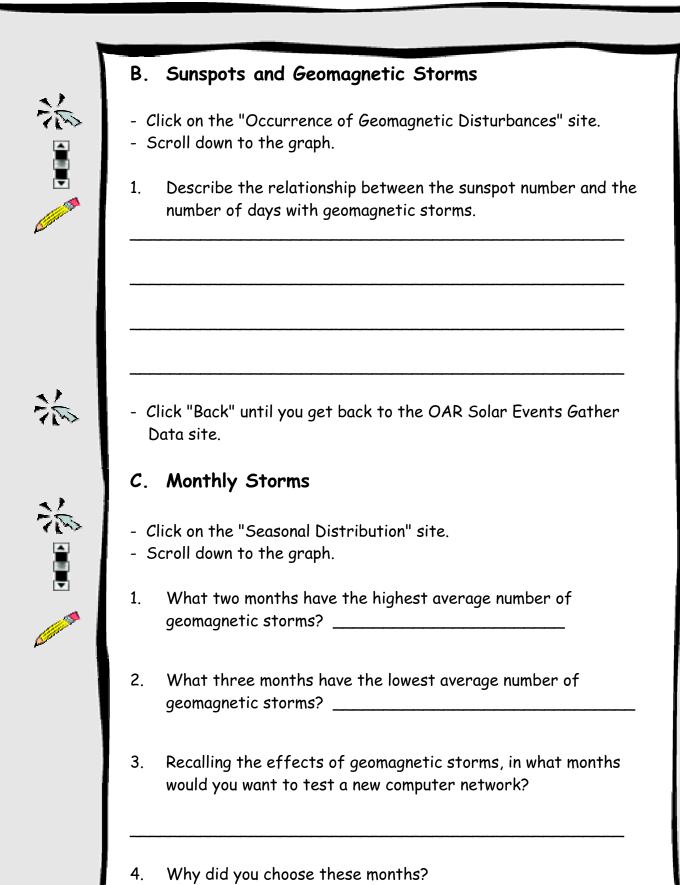
# II. Get Info A. General Information on Solar Problems - Click on the "Solar Events" site. - Read the information and answer the following question. What problems do solar events cause? 1. - Click the "Back" button at the top of the screen in your web browser until you get back to the OAR Solar Events Get Info site.



What does the ionosphere usually do to help communication the is changed by geomagnetic storms?
What dangers are there due to geomagnetic storms' disruption of the ionosphere?
How do geomagnetic storms affect satellites?
How can airlines be in danger due to geomagnetic storms?



### C. Solar "Power" Problems - Click on the "University of Michigan Power Grid" site. Why do geomagnetic storms affect structures made by people 1. more than they affect natural structures? - Click "Back" until you get back to the OAR Solar Events main screen. - Click "Gather Data". III. Gather Data A. Solar Flares and Magnetic Disturbance - Click on the "Solar Flare Effect" site. - Scroll down to the graph. Describe the relationship between X-ray radiation and the 1. magnetic field variation. - Click "Back" until you get back to the OAR Solar Events Gather Data site.



	Click "Back" until you get back to the OAR Solar Events Gatho Data site. Click "Forward" at the bottom of the screen.
D.	Annual Sunspot Numbers
	Click on the "Yearly Average Sunspot Numbers" site. Read the legend below the graph for help answering the ques
1.	Yearly sunspot numbers have been calculated using the ave of the <u>daily</u> number of sunspots. Which solar minimum yea the lowest yearly average?
	Click "Back" until you get back to the OAR Solar Events Gatho Data site.
Ε.	Math Facts and Solar Measurements
- (	Click on the "Solar Facts" site.
1.	The gravity on Earth is 9.8 meters per second per second. much stronger is the gravity on the surface of the sun?

2.	Escape velocity is how fast you have to go to escape the sun's gravity and not get sucked back into the sun. What is the esca velocity of the sun in kilometers per hour?
3.	What is the diameter of the sun?meter
4.	Use the diameter you found in question 3 to find the circumference of the sun. ( $C = -$ d)

5.	Use the rotation period of the sun, the number of hours in a day, the number of meters in a kilometer, and the circumference of the sun to figure out what the surface speed of the sun is in kilometers per hour. (How fast is it moving on the surface?)
6.	Use the fact that there are about 1.6 kilometers per mile to
	convert the speed you found in question 5 to miles per hour.
	lick "Back" until you get back to the OAR Solar Events main creen.
	/. Application  Variation
- T	lick on the "Variation" site. he "aa" index is used to measure the geomagnetic disturbances on arth.

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2. Besides the explanation that there are more disturbances, what other explanation is possible to explain the fact that the number of disturbances measured is increasing?  - Click "Back" until you get back to the OAR Solar Events Application site.  B. Cost vs. Cost  - Click on the "University of Michigan Solar Storm Cost" site.  1. What kinds of problems can be avoided if power companies get early warnings of coming geomagnetic storms?  - Click "Back" until you get back to the OAR Solar Events Application site.  - Click on the "Start-Up Problem" site.  2. Why should you turn off your electric appliances whenever there is a power failure?		What does the graph seem to tell us about the average number of geomagnetic disturbances?
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	1120	- Click on the "Start-Up Problem" site.



- Click "Back" until you get back to the OAR Solar Events Application site.

### C. International Accord



1.	Explain why the cost of maintaining an early warning system for geomagnetic storms is justified.

2. Why should all industrialized nations work together to set up the warning system?



- Click "Back" until you get back to the OAR Solar Events main screen.
- Click "Enrichment."

### V. Enrichment Activities

### A. Research

- 1. Research the Aurora Borealis. Find out when, where, and how they occur. Draw a diagram showing the areas on Earth where they occur most often.
- 2. Research when the next solar eclipse will be. What locations on Earth will see a total eclipse? a partial eclipse?
- 3. Research Earth's escape velocity. What is it and how is it different from the Sun's escape velocity? Ideally, satellites would be launched from the equator. What difference does it make where you launch a satellite from?
- 4. Find out about ancient cultures and how they created calendars and measured time based on the sun.

#### B. Interviews

- 1. Interview an astronomer at a local planetarium about locally-seen eclipses.
- 2. Work in groups and list all the songs you can think of that mention the sun.





### C. Related Web Sites

- NASA eclipse page http://umbra.nascom.nasa.gov/eclipse/
- 2. List of 1998 eclipses, meteor showers, and other phenomena http://www.sec.noaa.gov/ises/calendar/1998igc1.html
- 3. List of eclipses for the next ten years http://www.ips.gov.au/papers/richard/solar\_eclipse.html
- 4. National Geophysical Data Center site on geomagnetic data http://www.ngdc.noaa.gov/seg/potfld/geomag.html
- 5. Technically oriented National Geophysical Data Center site on cosmic rays

http://www.ngdc.noaa.gov/stp/SOLAR/COSMIC\_RAYS/cosmic.html